

This Page Is Inserted by IFW Operations
and is not a part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

**As rescanning documents *will not* correct images,
please do not report the images to the
Image Problem Mailbox.**

What is claimed is:

1. An optical device mounted substrate assembly comprising:

5 a ceramic substrate having a front surface and a first recess having an open end at least at the front surface;

10 an optical device mounted on the front surface of the ceramic substrate and having at least one of a light emitting portion and a light receiving portion, the optical device being to be optically connected to one of an optical waveguide and an optical fiber connector in a way as to align optical axes of the optical device and one of the optical waveguide and the optical fiber connector with each other;

15 a resin layer disposed in the first recess and having a second recess smaller in diameter than the first recess and having an open end at least at a side corresponding to the front surface; and

20 an alignment guide member fitted in the second recess and having a protruded portion protruding from the front surface of the ceramic substrate and fittingly engageable in an alignment hole of one of the optical waveguide and the optical fiber connector.

25 2. An optical device mounted substrate assembly according to claim 1, wherein the second recess is a high-precision machined hole, and the alignment guide member comprises a guide pin fitted in the high-precision machined hole.

30

3. An optical device mounted substrate assembly according to claim 1, wherein the resin layer contains an inorganic filler having a thermal conductivity

higher than that of a resin material forming the resin layer.

4. An optical device mounted substrate assembly
5 according to claim 1, wherein the ceramic substrate comprises two first recesses each having the resin layer formed with the second recess, the optical device being disposed between the second recesses.

10 5. An optical device mounted substrate assembly according to claim 1, wherein the ceramic substrate comprises at the front surface thereof a positioning reference portion that serves as a reference for
15 positioning of the optical device and for forming the second recess.

6. An optical device mounted substrate assembly according to claim 1, wherein the optical device is positioned with reference to the second recess.

20

7. A fabrication method of an optical device mounted substrate assembly including a ceramic substrate having a front surface and a first recess having an open end at least at the front surface, an
25 optical device mounted on the front surface of the ceramic substrate and having at least one of a light emitting portion and a light receiving portion, the optical device being to be optically connected to one of an optical waveguide and an optical fiber connector
30 in a way as to align optical axes of the optical device and one of the optical waveguide and the optical fiber connector with each other, a resin layer disposed in the first recess and having a second

recess smaller in diameter than the first recess and having an open end at least at a side corresponding to the front surface, and an alignment guide member fitted in the second recess and having a protruded
5 portion protruding from the front surface of the ceramic substrate and fittingly engageable in an alignment hole of one of the optical waveguide and the optical fiber connector, the method comprising:

10 a first perforating step of forming the first recess in an unsintered ceramic product by machining;

a firing step of firing the unsintered ceramic product to form the ceramic substrate;

a resin layer forming step of forming the resin layer in the first recess;

15 a second perforating step of forming the second recess in the resin layer by machining after the resin layer forming step; and

a guide member fitting step of fitting the alignment guide member in the second recess.

20

8. A fabrication method according to claim 7, wherein the first perforating step and the second perforating step comprise forming the first recess and the second recess so that the inner diameter of the
25 first recess after the firing step is larger than the inner diameter of the second recess and the outer diameter of the alignment guide member.

9. A fabrication method according to claim 7,
30 wherein the second perforating step comprises forming the second recess by high-precision machining.

10. A fabrication method according to claim 7, wherein the resin layer forming step comprises filling an uncured resin material in the first recess and curing the resin material.

5

11. A fabrication method according to claim 10, wherein the resin layer forming step comprises using, as the uncured resin material to be filled in the first recess, an uncured resin material containing an inorganic filler having a thermal conductivity higher than that of a resin material forming the resin layer.

10

12. An optical waveguide equipped optical device mounted substrate assembly comprising:

15

an optical waveguide;

a ceramic substrate having a front surface and a first recess having an open end at least at the front surface;

an optical device mounted on the front surface of the ceramic substrate and having at least one of a light emitting portion and a light receiving portion, the optical device being optically connected to the optical waveguide in a way as to align optical axes of the optical device and the optical waveguide with each other;

25

a resin layer disposed in the first recess and having a second recess smaller in diameter than the first recess and having an open end at least at a side corresponding to the front surface; and

30

an alignment guide member fitted in the second recess and having a protruded portion protruding from the front surface of the ceramic substrate and

fittingly engageable in an alignment hole of the optical waveguide.

13. An optical fiber connector equipped optical

5 device mounted substrate assembly comprising:

an optical fiber connector;

a ceramic substrate having a front surface and a first recess having an open end at least at the front surface;

10 an optical device mounted on the front surface of the ceramic substrate and having at least one of a light emitting portion and a light receiving portion, the optical device being optically connected to the optical fiber connector in a way as to align optical
15 axes of the optical device and the optical fiber connector with each other;

a resin layer disposed in the first recess and having a second recess smaller in diameter than the first recess and having an open end at least at a side
20 corresponding to the front surface; and

an alignment guide member fitted in the second recess and having a protruded portion protruding from the front surface of the ceramic substrate and fittingly engageable in an alignment hole of the
25 optical fiber connector.

14. A fabrication method of an optical waveguide equipped optical device mounted substrate assembly including an optical waveguide, a ceramic substrate

30 having a front surface and a first recess having an open end at least at the front surface, an optical device mounted on the front surface of the ceramic substrate and having at least one of a light emitting

portion and a light receiving portion, the optical device being optically connected to the optical waveguide in a way as to align optical axes of the optical device and the optical waveguide with each other, a resin layer mounted in the first recess and having a second recess smaller in diameter than the first recess and having an open end at least at a side corresponding to the front surface, and an alignment guide member fitted in the second recess and having a protruded portion protruding from the front surface of the ceramic substrate and fittingly engageable in an alignment hole of the optical waveguide, the method comprising:

an alignment hole forming step of forming the alignment hole in the optical waveguide;

a first perforating step of forming the first recess in an unsintered ceramic product by machining;

a firing step of firing the unsintered ceramic product to form the ceramic substrate;

a resin layer forming step of forming the resin layer in the first recess;

a second perforating step of forming the second recess in the resin layer by machining after the resin layer forming step;

a guide member fitting step of fitting the alignment guide member in the second recess; and

an alignment step of aligning the optical axes of the optical waveguide and the optical device with each other by fitting the alignment guide member in the alignment hole.

15. A fabrication method of an optical fiber connector equipped optical device mounted substrate

assembly including an optical fiber connector, a ceramic substrate having a front surface and a first recess having an open end at least at the front surface, an optical device mounted on the front surface of the ceramic substrate and having at least one of a light emitting portion and a light receiving portion, the optical device being optically connected to the optical fiber connector in a way as to align optical axes of the optical device and the optical fiber connector with each other, a resin layer disposed in the first recess and having a second recess smaller in diameter than the first recess and having an open end at least at a side corresponding to the front surface, and an alignment guide member fitted in the second recess and having a protruded portion protruding from the front surface of the ceramic substrate and fittingly engageable in an alignment hole of the optical fiber connector, the method comprising:

an alignment hole forming step of forming the alignment hole in the optical fiber connector;

a first perforating step of forming the first recess in an unsintered ceramic product by machining;

a firing step of firing the unsintered ceramic product to form the ceramic substrate;

a resin layer forming step of forming the resin layer in the first recess;

a second perforating step of forming the second recess in the resin layer by machining after the resin layer forming step;

a guide member fitting step of fitting the alignment guide member in the second recess; and

an alignment step of aligning the optical axes of the optical fiber connector and the optical device with each other by fittingly engaging the alignment guide member in the alignment hole.

5

16. An optical component equipped optical device mounted substrate assembly comprising:

an optical component having at least one of an optical transmission function, a light condensing
10 function and a light reflecting function, the optical component further having an optical component side alignment recess;

a substrate having a substrate side alignment recess;

15 an optical device mounted on the substrate and having at least one of a light emitting portion and a light receiving portion, the optical device being optically connected to the optical component in a way as to align optical axes of the optical device and the
20 optical component with each other; and

an alignment guide member fittingly engaged in the optical component side alignment recess and the substrate side alignment recess.

25 17. An optical device mounted substrate assembly comprising:

a substrate having a substrate side alignment recess;

an optical device mounted on the substrate and
30 having at least one of a light emitting portion and a light receiving portion, the optical device being to be optically connected to an optical component having at least one of an optical transmission function, a

light condensing function and a light reflecting function in a way as to align optical axes of the optical device and the optical component with each other; and

- 5 an alignment guide member fitted in the substrate side alignment recess and fittingly engageable in an optical component side alignment recess of the optical component.

10

15

20

25

30